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October 21st to November 20th inclusive.

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Mouldings, &c.—L. A. Groth (com.), 5508.

Music, &c.—G. D. Garvie and G. Wood, 5020 A. Banjer, 5287. W. Booth, 5432. W. H. Squire, 5469. W. Fischer, 5483.

Nails, Spikes, Bolts, Rivets, Screws, &c.—A. J. Boult (com.), 5517.

Neckties, Scarfs, Bows, Cravats.—G. Schubert, 5190. E. Jones, 5194.

Nets, &c.—G. Read, 5211.

Noxious Gases (Preventing) &c.—J. N. Moerath, 5162.

Nuts and Washers.—A. J. Boult (com.), 4688. H. Scott, 5289. R. Howorth, 5417. T. Hancock 5489.

Oiling or Lubricating, &c.—J. Deletbrey (com.), 5133. W. L. Wise (com.), 5379. P. M. Justice (com.), 5416.

Oils, Fatty Matters, Grease.—F. C. Glaser, 5044. J. Hislop, 5054. A. Parkes, 5388. J. Longman, 5464. W. P. Thompson (com.), 5466.

Ornamenting, &c.—C. Barlow 5169. R. G. Hodgetts, 5301. A. J. Nash, 5324. A. Tuck, 5395. J. Wetter (com.), 5445. A. J. Boult (com.), 5517.

Ovens and Kilns.—P. Jensen (com.), 5075. W. T. Goolden and C. J. Casella, 5107. S. de la G. Williams, 5132. C. D. Abel (com.), 5329. E. A. Brydges (com.), 5358.

Oxidation, (Preventing) &c.—I. Mangnall, 5177. T, and T. Kirkaldy, 5484.

Packing Pistons, &c.—H. W. Johns, 5428. C. Wheeler, 5490.

Packing Goods, &c.—A. W. Abrahams, 5127. W. T. Whiteman (com.), 5195. W. P. Thompson (com.), 5370.

Paints, Colours, Varnishes, &c.—J. Culmer, 5015.

Paper Pasteboard, Papier Mache, Paper Hangings.—W. Muirhead, 5154. C. Anderson and T. Cormic, 5180. F. Wrigley and J. Robertson, 5201. B. Schoof, 5352. J. A. Graham, 5365. C. Aitchison, 5381. T. Sowler and W. Pattison, 5444.

Pegs.—A. M. Clark (com.), 5274.

Pens, Penholders, Pencils, Pencil Cases, &c.—C. A. Drake, 5305. W. R. Lake (com.), 5461.

Photography and Photographic Apparatus, &c.—H. H. Lake (com.), 5131.

Pictures, Portraits, &c.—J. Fisher and T. Wolstencroft, 5374. A. J. Boult (com.), 5431.

Pipes, Tubes, and Syphons: Joining Pipes.—J. C. Johnson and R. Martin, 5019. E. Green, 5041. J. Wetter (com.), 5186. G. Little, 5202. W. Morgan Brown (com.), 5333. E. Nunan, 5272. T. Perkins, 5338. W. N. Hutchinson, 5393. C. Wheeler, 5490. T. Morgan (com.), 5514. J. Hunt and T. E. Mitton, 5520.

Preserving Food, &c.—C. M. Pielsticker, 5153. D. Fox and A. Wheeler, 5189. J. Y. Johnson (com.), 5219. W. H. Thew (com.), 5269. G. Kemworthy, 5336. W. P. Thompson (com.), 5370. M. E. and E. Pohl, 5437. H. H. Lake (com.), 5516.

Printing and Transferring: Type and other Surfaces for Printing, Composing, and Distributing Type.—R. Brown, R. W. Burnes and J. Bell, 5086, S. Cropper (com.), 5100. J. Gibson and J. Platt, 5330. S. Pitt (com.), 5346. R. B. Hayward, 5424. P. Stuart, 5441. T. Sowler and W. Pattison, 5444. W. W. Taylor, 5474.

Propelling Carriages, &c.—J. Wright (com.), 5119. A. Reckinzaun, 5354.

Propelling Machinery, Transmitting Power and Motion, Converting Movements.—W. Muirhead, 5154. W. R. Lake (com.), 5240. H. Thresher. 5350. J. Noad, H. Blackwell and H. Bunkell, 5369.

Propelling Ships, Propellers, Paddle-wheel, and Screws.—W. Tate, 5212. J. Y. Johnson (com.), 5218. J. Rebecca, 5268.

Pumps, Pumping and Forcing Liquids, Pumping and Raising Water and other Liquids, Pumps, Pistons, and Packing.—T. S. Greenaway and A. Kitt, 5101. F. A. Bonnefin, 5207. W. Morgan Brown (com.), 5233. C. Nelson, 5397.

Punching, or Perforating, &c.—C. Anderson and T. Cormic, 5180. A. J. Lehmann, 5386. J. D. Morrison, 5406.

Rags, &c.—B. P. Heyworth, 5040. E. Davies, 5067. C. Aitchison, 5381.

Railways, Carriages, Coupling, Uncoupling, and Altering Positions of Carriage and Engines.—M. P. W. Boulton and E. Perret, 4047. A. W. L. Reddie (com.), 5677. T. Smith, 5117. J. Wright, 5119. P. M. Justice (com.), 5140. Sir H. Bessemer, 5171. H. Wright and J. Pethick, 5267. H. P. Hogton, 5325. T. Scourfield, 5458. P. G. B. Westmacott, 5480.

Railway, Permanent Way, Rail Joints, Chairs and Sleepers, Portable Railways, Atmospheric Railways, Switches, Points, Crossings, and Turn-tables, &c.—J. Morison and R. Armstrong, 5038. A. W. L. Reddie (com.), 5077. J. Wright, (com.), 5119. L. Richards, 5145. L. Williams and D. Edwards, 5452. E. N. Molesworth-Hepworth, 5453. W. Pedley, 5499. E. N. M. Hepworth, 5587.

Reaping and Mowing, &c.—W. Mc J. Cranston (com.), 5191. T. H. Gillott, 5396.

Refrigerating and Freezing, Cooling Liquids, Making Ices, &c.—J. K. Kilbourn, 5076. J. Y. Johnson (com.), 5219. T. D. Kyle, 5256.

Registering, &c.—J. A. Muller, 5192. S. H. and J. C. Boswell, 5494.

Retorts.—J. Hislop, 5054.

Roads, Paths, &c.—J. H. Wood (com.), 5339.

Rods and Bars.—W, L. Hunt, 5143.

Ropes, &c.—J. H. Nute, 5057. J. Wright (com.), 5119. H. W. Johns, 5428. S. Hawkworth, 5472.

Sewing and Embroidering.—S. Pitt (com.), 5062. G. Browning, 5179. F. Simmons, 5209, F. O. Schmidt, 5413. W. R. Lake (com.), 5451.

Shears, &c.—A. J. Boult (com.), 5375.

Ships and Boats, &c.—A. J. Boult (com.), 5270. R. T. Pawley, 5476. J. and T. Kirkaldy, 5484.

Ships' Boats (Lowering) &c.—M. Burke, 5223. S. S. Sugden, 5389.

Ships Raising, (Sunken or Wrecked).—A. M. Clark (com.), 5385.

Shirts, Collars, &c.—J. Wetter (com.), 5213. J. W. Frost, 5216.

Shuttles, &c.—F. O. Schmidt, 5413.

Sifting, Sorting, and Separating, &c.—W. R. Lake (com.), 5318.

Teaching, &c.—J. Wetter, 5231.

Telegraphs; Telegraph Printing Apparatus.—R. C. Johnson and R. Martin, 5019. H. G. Ellen and J. T. Gent, 5126. J. G. Lorrain, 5164. H. Alabaster and T. E. Gatehouse, 5166. J. Imray (com.), 5182. G. E. Vaughan (com.), 5278. C. Green, 5391.

Tents, &c.—S. Schever, 5287.

Tickets, Labels, &c.—A. Ellison, 5302. C. A. Drake, 5305.

Tilling and Cultivating, &c.—E. Edwards (com.), 5012. A. Clarke, 5022. T. Hodgkinson, 5120. E. Savage, 5242. F. Proctor, 5248. S. Walter, 5284. F. Proctor, 5321. J. Clarkson, 5443.

Tobacco and Snuff, Cigars, Cigar-Holders, Pipe and Cigar-lighters, Smoking Pipes, Tobacco, Pouches, &c.—G. Weston, 5096. G. Howard (com.), 5479.

Tools, &c.—J. F. Allen, 5335.

Upholstery, &c.—H. M. Tarratt, 5100. A. M. Clark (com.), 5274.

Valves, Taps, Stop Cocks, Plugs; Regulating the Flow and Pressure of Fluids.—J. Dunbar, 5011. G. A. Biddie, 5027. H. and T. A. Greene, 5095. W. H. Noseley, 5144. J. Formby, 5200. A. W. Quinlan, 5502.

Washing, Cleansing, and Wringing Fabrics, Yarns, and Materials.—H. C. Smith, 5297.

Weaving, Braiding, Plaiting, Preparing for Weaving, &c.—T. M. Bykes and J. Hinchliffe, 5007. T. Singleton, 5049. J. Challinor, 5118. T. H. Brown, 5281. G. H. Snowden and O. Ball, 5475.

⁂ *The above List is prepared from the Patent Records by Mr. T. Morgan, Secretary of the Inventors' Patentright Association, Limited.*

The Lakes of North America.—It appears by the measurements recently taken by Government surveyors that the great lakes of North America boast the following vast relative capacities:—Lake Superior is 335 miles in length, and its greatest breadth is 160 miles; mean depth, 688 feet; elevation, 827 feet; area, 82,000 square miles. The greatest length of Lake Michigan is 300 miles; its greatest breadth 108 miles, but it is generally very narrow as compared with Lake Superior; mean depth, 690 feet; elevation, 506 feet; area, 23,000 square miles. The greatest length of Lake Huron is 300 miles; its greatest breadth 60 miles; mean depth, 600 feet; elevation 254 feet; area, 20,000 square miles. The greatest length of Lake Erie is 250 miles; its greatest breadth, 80 miles; mean depth, 84 feet; elevation, 261 feet; area, 6,000 square miles. The greatest length of Lake Ontario is 180; its greatest breadth is 65 miles; its mean depth is 500 feet: elevation, 261 feet; area, 6,000 square miles. The total of these five great lakes is 1,265 miles, covering an area of upwards of 135,000 square miles, thus affording natural advantages for navigation beyond any other part of the world.

A combined fish plate and nut lock has been patented by Mr. Daniel Faulkner, of Paris Crossing, Ind. The inner fish plate is of the ordinary construction, and the outer is thicker and extends to the top of the rail, having on its lower edge a flange forming an acute angle with the plate. A key, beveled on its lower side to fit the angle, has on its upper side a series of recesses corresponding with the bolts in the rails, one of which is the form of an acute angle, the others being square. When the nuts of the rails are turned square the key is driven under locking them. The nut over the angular recess is turned to fit the angle, locking the key in its place.

Reviews.

THE DOOMED COMET AND THE WORLD'S END.

"The Doomed Comet and the World's End." By J. A. Westwood Oliver. Published by Wyman and Sons, 74-76, Great Queen Street, London.

The title of this pamphlet, like some others on the subject of comets, is of a sensational character not to be commended. There is, however, in the contents, no attempt to prove either that the comet is actually doomed, or that the world is rapidly coming to a violent end. And although the reasoning employed may be somewhat loose, still the conclusions drawn are of a different character to what will be most naturally inferred from the title. Our own views on the absorption of comets by the sun will be found in an article of the present number.

SUBMARINA.

"Submarina." Published by Yates, Alexander, and Shepheard, 21, Castle Street, Holborn, London.

An anonymous pamphlet intending to be humorously satirical on the subject of the Channel Tunnel. The degree of success in this direction will, we think, depend in a great measure upon the sympathy of the reader. For ourselves, neither the humour nor the satire produced any disastrous results. We believe we must be slightly lacking in appreciation of such qualities.

MEN OF GENIUS AND UNHAPPY MARRIAGES.

"Men of Genius and Unhappy Marriages." By Henry Franks, Manchester.

This is an essay on a rather extraordinary subject. It was first read before the Manchester Literary Club, and is reprinted from the *Manchester Quarterly*. Its object is to shew that men of genius are utterly unfitted for the marriage tie. Whether Mr. Franks has entirely proved his position or not we do not care to say, but he has certainly made out a strong *prima facie* case. There is much in the paper to interest literary men and students of human nature, especially humanity of a certain exalted order.

ABSORPTION OF METALLIC OXIDES BY PLANTS.

From a series of experiments by F. C. Phillips, he states that it seems safe to conclude—

1. That healthy plants grown under favourable conditions may absorb through their roots small quantities of lead, zinc, copper, and arsenic.
2. That lead and zinc may enter the tissues in this way without causing any disturbance in the growth, nutrition, and functions of the plant.
3. That the compounds of copper and arsenic exert a distinctly poisonous influence, tending, when present in larger quantity, to check the formation of roots, and either killing the plant or so far reducing its vitality as to interfere with nutrition and growth.

In the case of the heavy metals, copper, zinc, arsenic, and lead, it seems to be probable that their oxides may, under certain circumstances, become deposited in the tissues of the plant. As to the manner in which this takes place, authorities differ.

It is supposed by Freytag and others that plants absorb all soluble matters indiscriminately, through their numberless rootlets, that the absorption of poisonous metals causes no disturbance until a certain degree of concentration is reached, when the plant rapidly withers and dies; that plants are therefore spared the sufferings of chronic poisoning, but are very susceptible to acute poisoning, which is invariably fatal; while it is held by others that plants absorb only such elements as are essential and nutritious, refusing to take up what is poisonous or innutritious; metallic compounds found in the analyses are therefore to be traced to atmospheric deposit adhering externally.

The theory of Freytag seems to have the weight of facts in its favour, and if it is possible that crops may become charged in this way with poisonous elements of the soil, it becomes a matter of the highest importance that wherever there is danger of such impregnation the most efficient means be employed for its aversion; for soil once impregnated with copper, lead, and zinc, may year after year bear crops poisoned in the same manner.

FISHING FOR RATS.

A NOVEL mode of catching rats is thus described in the *American Angler*. The writer says that a person having the patience of most fishermen can have much sport in hooking the vermin.

The warehouse adjoining his place of business is infested by these "file-tails," and our friend may be seen in the early spring, and late fall, on an occasional evening just after dusk, seated at the back window of his counting-room (overlooking the yard of the warehouse), with an ordinary rod in hand, strong linen line, and a spring hook, commonly called a "sockdolager." baited with a lump of fresh beef, patiently waiting for a bite. It does not tarry long nor does it consume itself in nibbles, but with a hungry snap the bait is seized and the hooks of the sockdolager impales the rat, when the excitement commences.

A lusty rat is no mean antagonist at the end of a pliant pole and ten feet of line, and his plunges, twistings, and straight-away dashes are more perplexing to the angler, than the leaps, surges, and sulkings of the gamy trout or bass. The rat is generally landed, after seasonable sport, and killed by a blow from a bludgeon.

In this connection we may state that thousands of small hooks are bought by sugar refiners for ratting purposes. The hooks are baited with small pieces of beef on each, and then distributed about the building. The rats swallow beef and hook—the first is digested, the latter is not—death of course results. The remedy is said to be infallible.

THE CONTRACTION OF METALS IN MELTING.

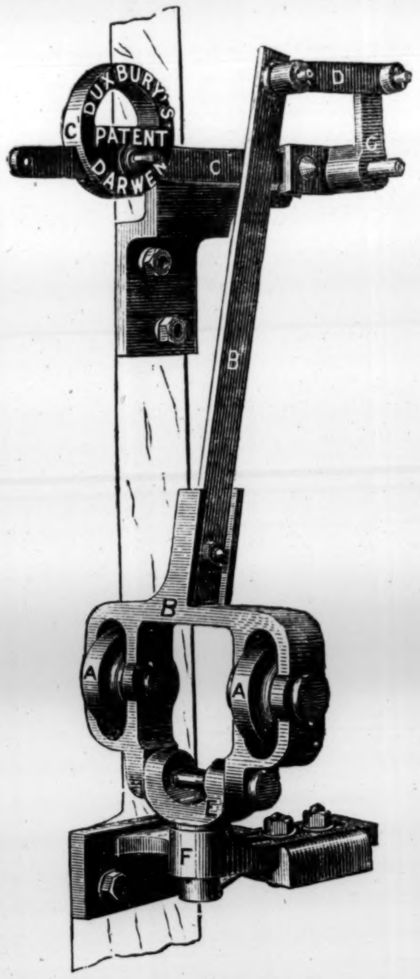
F. NIES and A. Winkelmann have examined the density of metals in a solid and in a liquid state, and find that, contrary to the generally accepted views on the subject, many melted metals expand when they solidify. The results of their experiments are embodied in a paper contributed to the Munich Academy of Sciences. Tin, slowly and carefully heated to its melting point, 2,265 degrees Celsius, floated on melted tin, and rose to its surface even after it had been submerged. By attaching pieces of copper to the floating tin it was found that the increase of density by melting over solid tin was 0·7 per cent., a difference which is almost as great as that between tin at the freezing and the boiling point of water. Lead and cadmium did not yield as decisive a result. Zinc, however, behaved like tin, but showed only a contraction of 0·2 per cent. In the case of bismuth the floating test is very easily carried out, as this metal shows as much as 3 per cent. Copper and iron showed a slight difference, the peculiarity in the case of iron being well-known, and having been the subject of elaborate investigations by Wrightson in England.

M. BURCQ, writing on the disinfecting and antiseptic action of copper, says that workers in copper, bronze, &c.. enjoy a practical immunity against cholera, typhoid fever, &c.

DUXBURY'S TENSION MOTION.

THE apparatus which we are able to illustrate is the invention of Mr. Yates Duxbury, junr., of Over Darwen, Lancashire, and is likely to be of a very useful character, for the special purpose it has in view.

It is applicable to tapeing or slashing machines, for the preparation of yarn for weaving, and also to paper or other machinery, as a friction or tension motion to regulate the winding-on of delicate fibres. In winding on motions for such purposes as hitherto mostly employed, the beam or roller on which it is intended to wind the yarn, paper fibre, or other analogous material, is suitably attached to a revolving apparatus carrying a friction plate. The driving-pulley is also attached to apparatus carrying another such friction plate, revolving parallel to the former one. These plates have their opposing faces prepared with flannel or other substance, so that when brought together by means of a screw-boss and intermediate spring, they form the frictional winding-on apparatus, as is well understood.



The apparatus shown is in lieu of the screw and spring hitherto used for the purpose of applying tensional driving as above described. It will be at once seen that the improvements consist in the application of a weighted lever, capable of exerting a known amount of pressure upon the friction plates, and which pressure is determined by the position of the weight on the lever arm, whereon it may be slided to any point, and fixed by means of a thumb-screw.

For the sake of clearness the friction plates are not shown, but the shaft carrying the same passes between the forked lever B. The pulleys AA form anti-friction bowls, pressing upon the plates aforesaid. These pulleys are carried by the lever BB′, which is fulcrumed upon the swivel E, to allow of the bowls following any deflections or variations in the plane of the disc's revolution. The end of the lever B′ is connected by link-motion D to the double-armed lever C, the long arm of which carries the weight.

There can be very little doubt that such a motion must be a great improvement upon the screw and spring now in vogue, and that its adoption will greatly reduce the amount of breakage of yarn or other fibre during tensional operations. Indeed, we are informed that in all the cases where the invention has been yet applied this very desirable result has been attained.

RECENT AMERICAN AND FOREIGN PATENTS.

Mr. Francis J. Carney, of Brooklyn, N.Y., has patented an improved *steam valve*. The valve plug is threaded externally, and is provided with two or more side openings. The valve box is threaded internally, and is of such size that the valve plug screws into it. Suitable devices are provided for packing the valve stem. As the valve plug is never entirely removed from the port no foreign matter can enter between the sides of the plug and the port, and the valve remains tight.

Mr. John M. Taylor, of Fredericton, Can., has patented an improved *window* for locomotives, cabs, steamboats, pilot-houses, &c. The window consists of a frame fitted with two sashes, glazed with glass or other transparent material, and a heating coil of pipe arranged between the glasses. The heating coil has an inlet and exhaust connection with the boiler, and keeps the window heated and free from ice and snow. Mr. Taylor has also patented a device to enable the engineer of a locomative to see ahead clearly when the engine is enveloped in smoke and steam. A funnel-shaped pipe projects from the cab window, ahead of the smoke stack, sufficient to prevent the snow thrown up by the plough from obscuring the front. The front end is closed with a window, and the tube and window are heated by steam pipes connected with the boiler.

Mr. John Gates, of Portland, Ore., has patented improved devices for operating the valves of direct acting steam pumps. The steam and pump cylinders are of the usual construction, the connecting piston rod having the usual block for operating the valve mechanism, consisting of two parallel bars pivoted to and connected by upright bars pivoted near their centres on the frame of the pump. The lower parallel bar is provided with adjustable stop blocks, against which the blocks on the piston press to move the bars, and the upper bar is hinged to the valve stem. Novel devices are provided for reversing the engine and regulating the throw of the valve.

Messrs. Thomas A. Lewis and George W. Call, of Urbana, Ill., have patented improvements in two-wheel *cultivators*. The cultivators are so constructed that they may be used with or without a tongue as the nature of the work may require. The wheels are so attached that they may diverge laterally to allow the axles and cultivator beams to maintain their proper relations to the beam of the cultivator. Devices are also provided for regulating the depth of the ploughs, and for raising the ploughs from the ground for transportation.

Improvements in armatures for dynamo-electric machines have been patented by Mr. Henry B. Sheridan, of Cleveland, O. The armature core is a hollow iron ring nearly square in its cross section, and is provided with ribs that cross its periphery, and their tapering ends are bent over and secured to the sides of the core. The helices are wound around the ribs and are held in place by plates secured by screws to the outer sides of the ribs. With this construction the greatest possible part of the helices is brought into the magnetic field.

GRADUATES OF TECHNICAL SCHOOLS AND THEIR PRACTICAL KNOWLEDGE.

By Edw. David Hearn, M.A., D.C.L.

The desirability of providing technical instruction for the operatives of this country has been frequently urged in the columns of the Scientific Review, yet the advantages that would result seem to be almost ignored by both employers and employed, and this apathy is encouraged by the constant efforts made to undervalue the opinions of graduates of technical schools by attempting to bolster up the crude, and often erroneous, views of those whose whole instruction has been limited to the rule-of-thumb teaching of the workshops. The Mining School graduate, for example, is by these non-progressive individuals regarded as inferior to the man whose knowledge has been obtained only by the breaking of ground, or otherwise working in, it may be, a single mine; and thus a course is pursued which is obstructive of mining prosperity, and therefore alike injurious pecuniarily to shareholders and to working miners. The same observations, *mutatis mutandis*, would apply to all branches of industry; but to simplify the argument Mining School students will alone be considered.

The importance of combining practice with science has always been strongly urged, and cannot be too energetically insisted upon; but when it becomes a matter of selection between the Mining School graduate and the illiterate "captain," who, giving him the benefit of every doubt, is fit only for the position of foreman of a gang of unskilled labourers, it is not difficult to see that the choice must necessarily fall upon the former. Hence the number of Cornishmen placed in control of foreign mines year by year diminishes, and even the centres of mining prosperity are but too certainly removing from districts controlled by these mere labour-foremen to those where technical training and scientific knowledge are brought to bear in the management of the mines. Little, it is true, could be said in favour of attending a Mining School in London where there are no mines, and where the student fresh from the provinces finds so many attractions in the shape of amusements, that his exercises become irksome; but there is nothing to excuse the Cornish miner for his neglect to obtain even the slightest scientific instruction offered him at home.

Acknowledging the fact that Cornish miners, although they may have reached the position of managers in Cornish or Devon mines, do not possess that scientific knowledge which would justify capitalists in entrusting them with the control of mines, or in accepting their opinion upon mining questions not connected with their own mine or district, it will be well to enquire whether there is similar absence of combined practical and scientific knowledge on the part of Mining School graduates, of whom those of the Clausthal Royal School of Mines in Hanover may be taken as representatives, just as Cornishmen have been taken as representatives of the labour-foreman class of managers. The professed object of the Clausthal School is to afford students an opportunity of obtaining such technical and scientific education as will qualify them to become managers of large mining and metallurgical works, and it will be seen that the Clausthal authorities do not fail to recognise the fact that science without practice is worthless. Hence admission as Bergakademiker or merely as Hospitanten depends upon the decision of the director, this decision being guided by the candidate's ability to show that he is sufficiently prepared to profit by the lectures and instruction which will be offered to him.

As to his theoretical knowledge it must be such as is obtainable in a first-class public school, or in one of the Prussian trade schools. Practical miners who have a sound acquaintance with elementary mathematics have no difficulty in becoming Bergakademiker at once. But none can become Clausthal graduates with theory alone; if they have had no previous practical training, the school gives it them by compelling them to attend the practical preparatory course, the aim of which is to give those persons who wish to be admitted to the School of Mines but are wanting in the practical preparation for it, an opportunity of becoming acquainted with mining, ore dressing, and smelting, so far as is necessary to enable them to understand the lectures relating to those subjects. The course lasts 24 weeks, one-third of the time being devoted to each subject respectively. The fee for each branch is 18 marks, or about £2 12s. 6d., for the three. Each branch has a special teacher who directs the instruction of the students. The students in the practical preparatory course are occupied at the works on week days from six a.m. till noon, The special teacher provides them with a qualified overseer or workman for special instruction. The afternoon is devoted to the preparation of a journal. Once a week the teacher who conducts the course gives a lecture on the work done and that proposed to be done next, looks through the journals, and fills up any gaps there may be in the knowledge of his students.

It is only now that the student begins to count terms in the School of Mines, and it is evident that he will have as much sound practical knowledge as a mere working miner could obtain in several years, if the latter enter the mine as a recipient of wages, so that the admission to the School of Mines, though the Bergakademiker should not attend a single lecture, would be an evidence that he is not without some practical knowledge. As to the scientific portion of the training the value of it has never been questioned even by the strongest opponents of technical schools; the sole charge has been that the students lacked the previous practical preparation to enable them to profit from the lectures. There are two sessions of about five months in the year, and the fees are 180 marks (about £9), exclusive of a charge of 140 marks (£7) for apparatus and reagents, and the student has to provide all glass and porcelain vessels as well as the smaller requisites. The standing of the professors—such as Prediger for mathematics, Hoppe for experimental physics, Hampe and Wünderlich for chemistry, and so on—is beyond question; and the entire curriculum is admirably arranged, so that the student who leaves the Clausthal School with the certificate of having satisfactorily completed the course will certainly be able to hold his own, and will, without doubt, possess that combination of practice with science so much demanded. It is technical education given upon this principle that has ever been advocated in the Scientific Review, and this is the kind of technical education which must be provided to enable England successfully to compete with foreign rivals, and to protect the interest of both capitalist and artisan.

Disinfection by Hot Air.—Koch and Wolfhugel, in experiments made to determine the disinfecting power of hot air, were led to the following conclusions: 1. Bacteria are destroyed by being exposed to a temperature of a little over 100° C. for an hour and a half. 2. Spores of brewer's mould require for their destruction an exposure for the same time at 110°-115° C. 3. Bacilli are killed only by three hours' exposure at 140° C. 4. The heat of hot air penetrates articles so slowly that in three or four hours' heating at 140° C. of small objects, such as a bundle of clothes, &c., disinfection was not secured. 5. Five hours' heating at 140° C., necessary to certain disinfection, does serious injury to most articles.

DESTROYING INSECTS UNDER GLASS.

The following method, says the *Revue Horticole*, has given most satisfactory results, and the inventor, M. Boizard, gardener to Baron Rothschild, at Paris, assures us that success is infallible—at least for three years during which he has been experimenting with it it has been so with him. He says: "Having procured two quarts of tobacco juice, I boil it over a slow fire on a furnace in the house. An hour and a half or two hours afterward, the liquid being reduced to about one-third its bulk, becomes viscid and almost solid, when, after having diluted it into one quart or 1½ quarts of water, I boil it more quickly until all get converted into vapour and fixed in the form of dew on every portion of the plants. I remarked no damage done, not even among the most tender plants, such as Adiantums, young plants of Blechnum braziliense, Coleus, &c Some young fronds of Adiantum alone suffered, but it should be added that they were on the stages." If danger were apprehended in the case of certain plants, they might be taken out or their safety assured by means of paper caps; and if it was a question of flowers or fruits, similar precautions might be taken to preserve them. M. Boizard assures us that no insect can resist this treatment, and that a greater portion of them do not appear again for six months. In the case of such as reappear quickly, it is easy to renew the operation, but then one quart of tobacco juice and one quart water will suffice. This method is as economical as any other, and M. Boizard says that it is possible to remain in the house during the operation without being inconvenienced thereby.

PHOTOGRAPH OF AN EXPLOSION.

The United States Engineers recently photographed the explosion of a wreck, which was blown to pieces by submarine charges of dynamite, to ascertain, among other things, how long the spectacle really lasted. The result was exceedingly interesting. There were six cameras employed, and the instant of the explosion, as also the several instants when the exposures were made by shutter, were electrically timed by a chronograph.

A photograph taken one-tenth of a second after the explosion showed the vessel broken, and a column of water 70 feet high; a photograph secured 1·5 seconds after the instant of explosion showed a column of water 160 feet high; a third photograph, taken 2·3 seconds after, showed the column at its full height of 180 feet, while fragments of wreckage were in the air, but none had fallen to disturb the surface of the water; a fourth picture, taken 3·3 seconds after, showed the column falling, and the surface of the water disturbed; whilst a fifth photograph, secured 4·3 seconds after, showed that all was over.—*Scientific American*.

Vegetarianism.—Experiments have been recently made by Herr Craner on the nutrition of a man in his sixty-fourth year, who had practised vegetarianism since he was eleven. The author arrives at these conclusions:—The *regime* of vegetarians affords food which is, both in absolute amount of nutritive matter, adequate to maintenance of bodily and mental functions, and in relative ratio of mixture sufficient. It suffices, however, for prolongation of life only because it depresses the quantity of vegetables by introduction of animal albumen in the form of milk and eggs. Yet this *regime*, where too great loading of the digestive system is to be avoided, is too dear to be recommended for sustenance of large bodies of men, as in poorhouses, barracks, and prisons: and, on the other hand, it is an eminently unpractical method of feeding man, since for the same price may be provided a much larger quantity of mixed, and therefore more utilisable food.

The Scientific Review

AND

SCIENTIFIC AND LITERARY REVIEW,

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SESSION 1882—1883.

December 14th, Conference on Patent Laws.

Subscriptions are payable to Mr. G. A. STRETTON, the Receiver, 4, St. Martin's-place, S.W., who is the proper official to give receipts.

F. W. CAMPIN, Sec.

Proceedings of the Institute.

December 28th, Executive and General Council Meeting.

The President and Council direct the attention of Members to early forwarding of subscriptions, as the work of the Institute is now likely to lead to considerable expense.

Monthly Notices.

Bridges.—The largest and oldest chain bridge in the world is said to be that of Kingtung, in China, where it forms a perfect road from the top of one mountain to another.

Deep Mines.—The deepest mine in the world, according to Prof. H. Hoefer, is the Przibram silver mine in Bohemia. The lowest depth is nearly 3,300 feet below the surface. At this depth the temperature of the rocks is only 75·00° F., and the temperature of the air 76·3° F.

Distinguishing Spurious Honey.—A solution of 20 parts of honey in 60 parts of water mixed with alcohol gives a heavy white precipitate of dextrine if glucose has been added, while genuine honey, if treated in the same manner, merely becomes milky.

A Floating Telephone Station.—Experiments have been made at Havre, France, to test a system of telephony between the Roads and the city. They have been so successful that it has been proposed to form a pontoon structure at a distance from the land, on board of which public telephones should be placed for use by the shipping in communicating with the land.

Mica Face Masks.—It is reported that the mica face masks made by Herr Raphael, in Breslau, are proving very beneficial to workmen exposed to great heat, acid fumes, flying sparks, or fragments of stone or metal. The mica plates are fixed in metallic frames, protected with asbestos. The masks cover the eyes more effectively than mica spectacles do, and the whole face as well. The neck and shoulders may at the same time be protected by a fireproof cape of asbestos or other proper material. The space between the masks and the face allows the use of inner glasses for improving the vision or shading the eyes. The tough and flexible mica prevents the breaking of the glasses by heat or flying fragments.

Malarial Germs.—The cause of malarial diseases is said to have been discovered by Prof. Laveran, a French physician, of Val-de-Grace. It is a very minute organism, named by him *Oscillaria malariæ.* M. Richard, who announced the discovery in the French Academy of Science, has found these microbes in all the fever patients of the Philippeville hospital in Algeria. These are located in the red blood-corpuscles, and completely destroy their contents. They can easily be rendered visible by treatment with acetic acid, but otherwise it is difficult to detect them in the corpuscles. They look like a necklace of black beads, with one or more projections, which penetrate the cell of the corpuscle, and oscillate or move like whips.

Lake Constance.—The shrinkage of Lake Constance, in Switzerland, owing to the extraordinary dryness of last winter, has brought to light many interesting relics. Among them there are bone and flint implements, harpoons, pottery, many specimens of which are intact, clubs, baskets, arrows, field tools, and animal remains. Among the latter are skeletons of the bear, the bison, and the moor-hen. The discovery also includes a considerable quantity of oats and wheat in a good state of preservation, and a remarkably perfect and artistically executed stag horn harpoon. The relics have all been removed to Frauenfeld, and added to the collection of the Local, Historical, and Natural History Society, which is now the richest in lacustrine objects in the Helvetic Confederation.

City and Guilds of London Institute.—The programme of technological examinations for the session of 1882-83 of the City and Guilds of London Institute has been issued. It acknowledges much difficulty in obtaining good technical teachers. The Institute now holds examinations in forty-two different subjects. The central building in Exhibition Road is rapidly approaching completion, and it is expected that when opened it will largely increase the supply of good technical teachers. Why?

The Transmission of Power to a Great Distance.—M. Deprez communicated the results of his experiments on the transmission of power to a great distance to the Académie des Sciences on the 9th ult. He used two telegraph wires between Miesbach and Munich, a distance of fifty-seven kilomètres. In a first experiment work equal to half a horse-power per second was got directly at Munich, with a velocity in the Miesbach machine of 1,500 turns a minute. More than 60 per cent of the work expended was recovered, the receiving machine working a centrifugal pump to feed a cascade.

THE SCIENTIFIC REVIEW
AND
Scientific and Literary Review
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DECEMBER, 1882.

WASTE LANDS.

It will doubtless be admitted by all persons, that in countries like Great Britain and Ireland, whose geographical situation is purely insular, and where there are no boundless prairies to which the surplus population can go and expend their energies, it is of the highest importance that every inch of soil should be cultivated to the fullest extent possible.

We have on these islands an ever increasing population, and practically there is not room for the people on our own soil; hence emigration, rather than migration, has to be adopted for the purpose of partially getting rid of the difficulty.

And yet we have an enormous area of land, which at present lies in utter waste, so far as the production of food is concerned. The best authorities give the number of acres of waste and common lands of England, Wales, and Ireland alone as 1,683,114, a tremendous total, truly, for so small a country. But we must add to this amount the vast moors and heather clad hill sides of Scotland, which will certainly bring the complete quantity for the whole kingdom up to between two and three millions of acres.

To make matters worse, there is a tendency constantly going on to lessen the amount of land under cultivation. Our large towns and business centres are perpetually extending themselves farther and farther into the domain of garden and field; and the increasing network of railways is also steadily stealing a large acreage of arable land from the hands of the farmer, who in turn is year by year more and more placed at the mercy of foreign competition.

Apart from all considerations of a political character, the enormous amount of land running to utter waste in these tight little islands strikes the practically scientific mind as something absurdly foolish, if not to some extent nationally criminal. Surely it is the bounden duty of a people to see that, when due provision is made for healthful recreation, their commons and waste places shall, as far as possible, be reclaimed; especially now that scientific agriculture has placed powers in our hands of which our forefathers knew little or nothing. And although we cannot in these days hope to reproduce the condition of things when, as has been said or sung, "every rood of ground maintained its man," we may nevertheless do something which will, to a very respectable extent, increase the amount of home acreage kept under cultivation.

For the carrying out of a purpose of this kind, there is no doubt that convict labour could be usefully employed, to the advantage of the whole nation; thus forming a direct saving to that long-suffering class, the taxpayers of Great Britain.

Even under our present arrangements much could be done to increase production, as every person who has travelled on the Continent will readily understand. Along the lines of many Continental railways the embankments and margins of the track are cultivated with kitchen garden stuffs, and in some cases with cereals. In England there are even whole lengths of abandoned railroad lying utterly waste, without taking into consideration the land adjoining working lines.

Again, there are long reaches of coast land, which a very little engineering skill, combined with the requisite energy and capital, could make not only useful but remunerative; whereas such is at present, for many square miles in continuous connection, allowed to be covered by shallow water at high tides.

There are also the marsh or bog lands, most of which are capable of drainage; and if the works were allowed to extend over a number of years, the cost would scarcely be felt. In this regard something more than increase in cultivation woold be obtained; as by the removal of the stagnant moisture of these morasses, a constant cause of disease would be effectually abolished. The amount of ague, intermittent fevers, &c., suffered at present by the people compelled to live in the neighbourhood of these low lying swamps, is something dreadful to contemplate; and if all the cases directly traceable to these miles of saturated vegetation could be put into tabulated form, they would become a startling commentary on our present supineness with regard to this subject.

There are, in fact, several advantages to be derived from land reclamation, other than the increase in cultivation; for example, the reclaiming of land from the sea shore, which is invariably possible in shallow far stretching bays on flat parts of the coast. In the majority of such cases, the quickest and most practicable course would be to make a raised substantial roadway almost straight across the bay, which would substitute or supplement the high road usually found to wind around the most distant margin of the highest tides. This embankment would form a road for the vehicular and other traffic of the inhabitants of such parts, which in some cases we could point out would be a saving of miles in the distance from one town to another. And where such road is, or could be, a railway, the importance of this distance would be greater still. Once such a road made, the reclamation of the land behind, by means of subsidiary embankments and the requisite drainage, could proceed by degrees yearly, until the whole were brought under cultivation.

Of course this kind of work would have to be undertaken as a national matter under Government control; but the minor works we have pointed out, such as the planting of the embankments of the railway with garden stuffs; the converting of disused or abandoned lines of railway into orchards or arable land; and the enclosure of all the commons and such like waste pieces for garden cultivation, could be set about at once by enterprising individuals, provided the requisite legal powers exist, or can be obtained, and about which there certainly ought to be no difficulty.

W. G.

Proceedings of Societies.

NUMISMATIC SOCIETY.

October 19.—Mr. W. S. W. Vaux, V.P., in the chair.—Mr. E. K. Burstal exhibited a gold coin of the British prince Andoco(mius), found at Thame. and a half-groat of Henry VI. (light weight).—Mr. R. A. Hoblyn exhibited a set of the touch-pieces struck by the Stuarts, viz., Charles II. (in gold); James II., from a different die (in silver); the Chevalier St. George as James III. (in silver); the young Pretender as Charles III. (in silver); Henry, Cardinal of York, as Henry IX. (in silver); Anne (in gold). Before the reign of Charles II. no coins were struck specially for touch-pieces, the gold "angel" having been used for this purpose. The touch-pieces are all similar in design. Those of the Pretenders, however, which were struck abroad, are of much better work than those made in England. Mr. Hoblyn remarked that Anne was the last English sovereign who touched for the "king's evil," George I. having been, it is said, in the habit of referring all applicants to James Edward, the elder Pretender. These touch-pieces (all of them perforated) are curious relics of a superstition which had existed for many centuries, and was only stamped out on the accession of the Brunswick dynasty.—Prof. Gardner read extracts from a paper describing the coins of the island of Samos, and discussing the historical facts to be gleaned from them.

SOCIETY FOR THE PROMOTION OF HELLENIC STUDIES.

October 19.—Prof. C. T. Newton, V.P., in the chair.—Prof. Jebb read notes on a recent visit to the Troad, where he examined Dr. Schliemann's excavations at Hissarlik. In his opinion, and that of his companions, two of them were architects, the remains do not warrant the theory of seven successive cities assumed in "Ilios," or the corrected hypothesis of six cities which has since been put forward. Nor can any scientific theory of such a theory be founded on the pottery or other objects found in the diggings. On this point attention was called to the evidence of M. Albert Dumont. Prof. Jebb proceeded to define the only sense in which Hissarlik can be identified with Homeric Troy. It was possibly the site of a town of which the siege gave rise to the tale of Troy. It may also represent the position of Troy as generally conceived by the poet, though no one site in the Troad suits all the topographical data of the Iliad. But the town of Troy, as indicated in the Iliad, cannot be recognised in any remains found at Hissarlik. The poet's town of Troy was a creation of his fancy, influenced by handsome cities of his own time. Prof. Jebb concluded with an appreciative tribute to Dr. Schlieman's energy and perseverance. The paper will appear in the next number of the *Journal of Hellenic Studies*.—After some discussion, in which the Chairman, Mr. W. M. Ramsay, Mr. F. Pollock, and others took part, Mr. L. R. Farnell read an exhaustive paper on the altar frieze lately discovered at Pergamon, which represents the battle between the gods and giants. Referring first to the treatment of the subject in Greek literature, the writer proceeded to compare the Pergamene work with other known representations of the Gigantomachia both on vases and in sculpture, and showed how in fulness of conception and boldness of execution this was a remarkable advance upon the earlier treatment of the subject, and constituted an invaluabe contribution to the history of the later development of Greek art. This paper also will appear in the forthcoming number of the *Journal of Hellenic Studies*.

AMMONIA FOR EXTINGUISHING PETROLEUM FIRES.

A committee of the Polytechnic Society of Munich has issued a report on the means to be employed for extinguishing burning petroleum. They say that since concentrated water of ammonia evolves a great amount of gas when heated, and as this gas is unable to sustain the combustion of any burning substance, burning petroleum must also be extinguished for want of oxygen if brought into a space filled with ammonia gas, and it may safely be asserted that petroleum will not continue to burn even in a room filled with atmospheric air, when there is a considerable quantity of ammonia gas mixed with the air, assuming, of course, that the place is closed so as to prevent a free interchange of air and cut off the excess of a fresh quantity of oxygen to support combustion.

A second condition necessary for success, which is intimately associated with the first, is that the space be not much larger than that of an ordinary house-cellar, so that there shall only be a small number of barrels of oil, as is the case with a retail dealer. It may be assumed with certainty that it would be in vain to attempt to put out a fire in a large store-house with ammonia.

Finally, the third condition is that the ammonia be used in large amount and of sufficient strength. The ordinary commercial aqua ammonia has a specific gravity of 0·906, and contains nearly 10 per cent by weight of ammonia gas, but it can be made a good deal stronger, for *cold* water absorbs so much ammonia gas that when the water is perfectly saturated with this gas the solution contains nearly 47 per cent of ammonia. The stronger it can be used, the more gaseous ammonia will be evolved on heating it, and the more efficient it will be for extinguishing a fire. But in no cases should ammonia water be used that has a higher epecific gravity than 0·960, and hence contains less than 10 per cent of gas.

Unfortunately it is impossible to say definitely how much ammonia ought to be kept in a petroleum room as a precaution against fire. For while it is easy to determine the cubical contents of the room, experience is lacking to tell what volume of ammonia must be mixed with a given volume of air to extinguish a flame in it. Nor is it possible to tell how much of the ammonia which is there will be evaporated if a fire breaks out, and how much ammonia gas will be evolved and mixed with the air. Yet there will only be a greater or smaller portion of ammonia liberated according to how much heat is produced.

In 1881, Schlumberger proposed to extinguish a fire in a petroleum store quickly at the outset by keeping a large closely-stoppered bottle of concentrated ammonia on every barrel, so that in case of a fire or explosion the bottles would break and the evolved fumes of ammonia prevent the fire from spreading any further. Schlumberger employed this simple method with the best results in his extensive experiments on the distillation of petroleum.

Assuming that a large bottle held 10 litres of water of ammonia, and this contained but 10 per cent of gas, so that in the 20 litres there is dissolved not quite 2 kilos. (1,920 grms.) of ammonia, and if, on the breaking out of a fire, only half of it vapourises or is converted into gas, it would still fill quite a large space with ammonia gas. The weight of a litre of ammonia gas is at 0° C., and under the normal pressure only 0·7617 grm., so that 1 litre of liquid ammonia would produce 1·313 cubic metres (48½ cubic feet) of gaseous ammonia, measured at the freezing point of water. At the high temperature produced by the burning oil the gas would naturally expand and fill a much larger space.

The use of water of ammonia as a preventive of petroleum fires, or rather to extinguish a fire that breaks out in a small store of it, ought to attract the attention of companies and societies concerned in extinguishing fires, and although the matter has not yet been so thoroughly tested that the owners of these store-houses can be *compelled*, as Schlumberger proposed, to keep closed bottles full of ammonia in the cellars where petroleum is stored, it might be well to recommend that this should be done, leaving it to the owners, if they would consult their own interest, to carry it out.—*Deutsche Industrie Zeitung*.

IRRITATING EFFECTS OF STINGS IN THE ANIMAL AND VEGETABLE KINGDOM.

It is well known that the effect of a stinging nettle on the skin agrees very closely with the sensation produced by the sting of a bee or wasp. But the great similarity is not limited to the feelings it produces, but the cause of the irritation produced on the skin is essentially the same. It may be considered as settled that formic acid is present in the poison sac of the bee sting. The same corrosive acid also occurs in the sting of the nettle. Some species of caterpillars have formic acid in some of their hairs, which they shake off at will, and when a person touches such a caterpillar the poison penetrates the skin and causes burning, itching, and inflammation. These poisonous hairs preserve their irritating powers even after the death of the worm. This accounts for statements that visitors to collections of caterpillars have suffered from eruptions on the neck.

Professor August Vogel, of Munich, says:—"Many hairy caterpillars cause itching and burning of the skin when touched, and sometimes it gives rise to swelling and redness. This depends on the fine hairs, which produce the same effect when they float around in the air. Many ladies who visited the caterpillar room of the naturalist Reaumur had a breaking out on the neck."

In the sting of the bee, wasp, hornet, &c., a minute drop of a transparent liquid may be observed on the sting, and is called "bee poison" (formic acid). It penetrates into the wound produced by the sting, and causes the well known effects. It would, however, be a great mistake to assume that the only object of this is to injure. It has a far more important purpose, namely, to prevent fermentation and decay. The celebrated bee cultivator, Holz, says, that in his long experience with honey, that which came from what are called "rancorous swarms" (boshaft) had peculiar properties. It had a bitter, harsh taste, and its smell was sharp. We know that bees, when disturbed, run out their stings, on the end of which may be seen a tiny drop. This drop, as we have already said, is formic acid. When the disturbance is at an end they draw in their stings again, but the drop of liquid does not go back with it, but is wiped off on the comb, and sooner or later gets mixed up with the honey. This explains how honey from such excited bees must taste and smell sharper than from peaceable bees. Excitable bees will rub off this little drop of formic acid more frequently than other bees; perhaps a larger drop is formed by nervous bees than by those that are not nervous, and hence the honey is richer in formic acid. This acid is never absent in genuine honey, but the amount differs. The contamination is not only uninjurious but very useful, in fact necessary, it keeps the honey from spoiling; we know, indeed, that purified honey, from which the formic acid has been removed, very soon ferments, while unpurified honey will keep unchanged for years. Nature furnishes the bees with this knowledge instinctively, and therefore they do not carry this drop of formic acid away out of the hive. Bee connoiseurs say that the bees add it to the nectar which they collect that is free from it so as to make it keep, and they do this in places where they are not disturbed.

Two hundred years ago formic acid was made from the brown wood ants, by triturating them with water and distilling it. The acid liquid was used to irritate the skin. The reddening of the skin, by using baths of pine leaves, is also due to the action of the formic acid. The anti-fermentative action of formic acid has long been recognised.

As regards the irritative action of stinging nettles and other similar vegetables, it depends, as already stated, on its formic acid. The point of the nettles is brittle as glass, and by the slightest touch penetrates the skin and breaks off, pouring out its acid and causing the burning sensation.

THE THREATENING COMET.

We have, during many years of active scientific life, been strongly impressed with the idea that it is the special work of science to dispel the superstitious fears of the general public; and by consequence, we are not a little chagrined to find respectable journalists, and even writers for what should be scientific periodicals, positively making astronomical speculations into a veritable engine of terror to the multitude. All kinds of sensational articles are being put forward with regard to the great comet which has so recently appeared in our morning skies. In these productions it is sought to be demonstrated that on the absorption of the comet by the sun (which event is predicted without a suspicion of error on the part of the various writers), this poor earth of ours will be literally burnt up by the enormous heat thereby engendered. Naturally enough, such an idea is seized with avidity by those gloomy theologians amongst us, who are always so anxious to destroy not only the earth, but the whole universe, by fire, for the purpose of fulfilling what they erroneously conceive to be divine predictions. That such a doctrine as the destruction of the earth by means of a comet should be propounded is by no means surprising, considering the love of the marvellous so strongly developed in our midst; but the same is none the less contrary to the best teachings of science, and it is a mystery to us how any man with a pretence to astronomical and mathematical knowledge should propagate such injurious dogmas.

We will try and make it somewhat clear to our non-professional readers that no such dire results can possibly arise from the absorption, on the part of the sun, of comets, even when such are as large, or much larger, than the great comet of 1882.

Every one knows that the gravities of bodies decrease in ratio of the square of their distance apart. It will thus readily be understood that when a comet recedes to a very great distance indeed from the sun, the force of gravity, and consequently its rate of motion through space, will be very small indeed. And if the comet were removed to a distance which is great enough to be practically treated as infinite, the motion also would have to be conceived as infinitely small. In fact the difference of velocity between any two indefinitely great distances from the sun is so slight that a mass of matter starting from a distance of 10 billions of miles would reach the sun with a final velocity, only a fraction of an inch per second less than if it had been falling from all eternity. It thus happens that a comet starting from about half the distance between the sun and Alpha Centauri—the nearest known fixed star,—will acquire a speed at the sun's surface practically equal to that of a body falling to the sun from an infinite distance.

Now what is such a speed? If a body be let fall near the surface of the earth, it can be shewn by experiment that at the end of one second it has acquired a velocity of 32·2078 ft. per second. This therefore becomes an expression for the force of gravity, exerted by the mass of the earth on bodies near its surface. Now, in consequence of the labours of Sir Isaac Newton, we know that the velocity acquired by a falling body at the instant of impact, after starting from infinity, is equal to the square root of the product of twice the intensity of gravity, multiplied by the radius of the earth. Applying this rule we have twice the force of gravity as 64·4156, and the mean equatorial radius of the earth as 20,923,161 ft. The square root of the product of these numbers is 36·645 ft., or nearly seven miles per second, as the velocity of a mass falling on the earth from an infinite distance. But the force of gravity at the sun is nearly 28 times stronger than at the surface of the earth. It follows, therefore, by extending the calculation to that extent, that the speed of impact of cosmic matter on the sun is nearly 55 times greater than on the earth, being no less than 380 miles per second, and the velocity is very little less if we substitute the distance of the orbit of Neptune for infinity. Having obtained this, it is easy to tell the speed of a body at any point in its flight. Thus, allowing for the distance of the earth from the sun, it is found that a body passing our world from stellar space on its way to our solar centre has a velocity of about 26 miles per second, which thus becomes the greatest possible speed with which anything can strike the earth.

Now motion is a mode of force or energy, and whenever it is arrested or retarded its exact equivalent of heat is evolved. We see this exemplified in the flash emitted when a cannon shot strikes the target; in the sparks arising from a brake when forced on to the wheels of a railway train; and in numerous other ways. Professor Joule determined what is the exact equivalent of heat to a given motion, which may be expressed as follows:—if a pound of water is let fall 772 feet, on being suddenly arrested by the earth's surface, it will generate just one degree Fahrenheit of heat throughout its mass. Bringing the great Newton's law of gravity to bear again, we ascertain the velocity from the height named to be 223 ft. per second, with which useful number we may at once convert any conceivable velocity into its heat equivalent. The rule most convenient for finding the amount of heat evolved by the determination of motion is to multiply the square of the velocity in ft. per second by the reciprocal of the square of 223, which latter is 0·00002010899.

Putting this rule into practice with the numbers we already have, we find that the intensity of heat, which would be produced by the *instantaneous* stoppage of a body falling on the sun from a distance of say 10 billions of miles, would reach the tremendous amount of about 80,000,000 degrees Fahrenheit.

Now we surmise that our sensational friends, having arrived at this stage, have been content to take it for granted that the impact of a comet would raise the heat of the sun to this extent, and probably may not care to be told, that nothing of the kind can possibly occur; nor in fact can the absorption of a comet be attended with any evil results whatever.

It is required, for the forming of correct conclusions on this subject, to bear in mind that the velocities of impact we have described are those of interstellar masses falling on the sun with unimpeded motion in straight lines. And further, that instantaneous stoppage of a comet's motion would require the sun's surface to be equal in density to solid platinum. It is surely needless to state that neither of these conditions are fulfilled in the case under consideration. In the first place, any comet that can make impact must move many times around the sun before it can come in collision, its perihelion at each circuit approaching nearer until eventually it would be so far retarded by gases in the vicinity of the sun that its orbit would nearly coincide with the solar surface. Then, if both the sun and nucleus of the comet were solid, the latter would ricochet like a cannon ball, and would thus, surrender portions of its heat at each impact, every succeeding contact giving off less heat in consequence of retardation from angular fall. But we are here brought face to face with the fact that the sun's density is less than one and a half times that of water. A comet with a solid nucleus would thus bury itself in the substance of the sun, and be brought gradually to rest in a similar manner to a railway train being brought to a standstill by means of a powerful brake. Heat is well known to be a mode of motion of an atomic character, the greater the motion of the atoms the more intense is the heat. In the case of a concrete moving body each atom maintains its relative position to the others, and no heat is developed. When collision occurs, unless the whole of the motion of translation is instantly changed into atomic motion, the maximum heat will not appear. A comet coming in direct contact with the sun would plunge thousands of miles beneath its surface, and the heat engendered would slowly radiate, bringing great blessings to man, instead of destruction.

There is another portion of the subject which our alarmist friends either ignore or they fail to discriminate, viz., the difference between the *intensity* of heat and the *quantity* thereof. We have repeatedly observed the tendency to the same difficulty in electricity, and persons who come to wrong conclusions in the one case, very frequently follow the same course in the other. Heat depends for its intensity entirely on velocity and not on mass. Whether the weight of the comet be one pound or a thousand tons, the final velocity and consequent intensity of the heat developed will be identically the same. The length of a heat-wave of 80,000,000 degrees would be less than one-two millionth part of a second, so that if such were radiated it is doubtful, considering the disproportionate mass of any comet we know and the distance from the sun, whether we should be sensible of the fact, except with the help of very delicate instruments.

We must remember the sun is a colossal globe 860,000 miles in diameter, being in its mass equal to 331,654 earths. Can any reasonable person imagine that the absorption of a poor comet by such a mighty orb is attended by any calamity? Indeed, we have no hesitation in saying that there have recently been disturbances on the sun equal to what would be the result of the inrush of half-a-dozen comets at once. And further, we are of the deliberate opinion, that although mankind has never yet been fortunate enough to observe such phenomena the absorption of comets has repeatedly taken place, and is probably a relatively common occurrence; nevertheless it is possible that in the great majority of cases they are first broken up in their final revolutions, and that they go in, so to speak, piecemeal, in the form of meteoric showers. In such-like enormous and almost continuous downpours of matter, we believe, will be found the true fuel of the sun.

TRUE DISINFECTANTS.

Many a so-called disinfectant is employed to-day in a certain solution, when it does not possess any value whatever under the circumstances. If it is really our intention to disinfect wounds, we must be certain, at least, that we will achieve our object with the remedy we use; if such is not the case, we only irritate without doing good.

The Imperial Board of Health in Berlin has published a number of experiments which have been made by Dr. P. Koch, with the view of establishing the real value of many so called disinfectants. It would lead us too far to give the whole procedure employed to ascertain the facts mentioned, and we will, therefore, confine ourselves to giving the more important results of the investigations of this celebrated physician.

Most surgeons have been satisfied to wash their hands and clean their instruments with a 2 per cent. solution of carbolic acid. Such a solution is almost inert, and a 5 per cent solution is necessary to achieve the desired object.

But what is the most interesting is the fact that *carbolic acid dissolved in oil or water proved itself totally inert!* What do our surgeons who still make use of so-called carbolized oil say to that? Koch found that carbolic acid, when dissolved in oil or in alcohol, had not the slightest influence on the vitality of any of the micrococci or bacilli.

Concerning sulphurous acid, it was found to be powerless against spores: bacilli and micrococci, when exposed to the fumes in a box, were killed within twenty minutes, but were very little influenced, or not at all, when exposed to the fumes in a room at the usual temperature.

Chloride of zinc showed itself just as harmless. A 5 per cent. solution exerted absolutely no influence on the spores of anthrax, notwithstanding the same had been exposed to the action of the remedy for a period of thirty days.

Of other drugs, the spores of the bacilli were killed by chlorine water, fresh prepared; 2 per cent bromine water, 1 per cent aqueous solution of corrosive sublimate, 5 per cent solution of permanganate of potassium, 1 per cent osmic acid, within one day; formic acid, four days; ol. terebinth, five days; solution of chloride of iron, four days; 1 per cent arsenious acid, 1 per cent quinine (water with muriatic acid), 2 per cent muriatic acid within ten days; ether within thirty days.

Inert or possessing very little influence; distilled water, alcohol, glycerine, oil, sulphur-carbon, chloroform, benzol, petroleum ether, ammonia, concentrated solution of common salt, bromide and iodide of potassium, 1 per cent; sulphuric acid, sulphate of zinc and copper, alum, 1 per cent; perman. of potash, chromic acid, the chromates and bichromates, chlorate of potash, 5 per cent; boracic acid, 5 per cent; acetic acid, 5 per cent; tannic acid, 5 per cent; benzoate of sodium, 5 per cent; quinine (2 per cent in water 40, alcohol 60), iodine (1 per cent in alcohol), thymol (5 per cent in alcohol), salicylic acid (5 per cent in alcohol, 2 per cent in oil).

As regards remedies which prevent the further development of spores, the following results were obtained. The first number means retarding the development, the rest totally preventing it:

Corrosive sublimate	1 : 1,600,000	1 : 320,000
Oil of sinapis,	1 : 330,000	1 : 33,000
Arsenite of potash,	1 : 100,000	1 : 10,000
Thymol,	1 : 80,000	
Ol. terebinth,	1 : 75,000	
Hydrocyanic acid,	1 : 40,000	1 : 8,000
Oil of peppermint,	1 : 33,000	
Chromic acid,	1 : 10,000	1 : 5,000
Picric acid,	1 : 10,000	1 : 5,000
Iodine,	1 : 5,000	
Salicylic acid,	1 : 3,300	1 : 1,500
Permang. of pot.,	1 : 3,000	
Muriatic acid,	1 : 2,500	1 : 1,700
Camphor,	1 : 2,500	
Eucalyptol,	1 : 2,500	
Benzoic acid,	1 : 2,000	
Borax,	1 : 2,000	1 : 700
Carbolic acid,	1 : 1,250	1 : 300

But as, for purposes of disinfection, the micro-organisms must be killed, and in the shortest possible period, and the effect of retarding the development of the spores (antiseptic) is not sufficient, only the following remedies can, according to Koch's experiments, be said to be of value: corrosive sublimate, chlorine, bromine, iodine. Bromine in form of vapour is, as concerns rapidity of action, superior to chlorine and iodine.—*Med. and Surg. Rep.*

RING SPINNING.

By degrees this method of spinning yarn is coming into operation throughout the textile manufacturing portions of England, in contradistinction to the older "flyer," or "throstle" machinery.

The advantages to be derived from the ring frame are, increased production, saving in power, saving in wages, and saving in wear and tear. Besides these, the operations of piercing and doffing are so simple that they are easily learnt, and both, when the attendants have acquired skill, are more quickly performed than on the flyer frame. A good ring frame will spin 20 per cent more than a flyer frame. Suppose a certain quantity of yarn is wanted per week. It will require fewer spindles, a smaller mill, smaller engines and boilers, less mill-gearing, and fewer spinners, doffers, and overlookers, if ring frames are used, than it will if flyer frames are used. Say, for example, 40,000 lbs. of 30's are wanted per week. To spin this weight 40,000 ring spindles would be required, or 49,230 flyer spindles. The 40,000 ring spindles would occupy about 26,000 sq. ft. of floor space, while the 49,230 flyer spindles would occupy about 32,000 sq. ft. The 40,000 ring spindles would be driven by engines of about 330 horse-power, but it would take about 470 horse-power for the 49,230 flyer spindles. To mind the 40,000 ring spindles about 80 spinners would be required, whilst 100 or more would be wanted for the 49,230 flyer spindles. If the ring frames are reckoned at 8s. 6d. per spindle, the cost of 40,000 will be £17,000. The flyer frames at 6s. 9d. per spindle would cost for 49,230, £16,615, or £385 less than the ring frames. Against this £385 there is to be set the saving of 666 sq. yards of floor space, with gearing, steam and gas, piping, and the saving in cost of engines and boilers.

Perhaps one reason for the introduction of ring spinning being somewhat retarded has hitherto been a want of knowledge of the conditions upon which alone such can be successfully carried on. They may be briefly stated thus:—accuracy in the machine and cleanliness of the spinner. The points requiring the special attention of the machine maker are the following:—the spindles must be light, stiff, free in their bearings, true, steady at high speeds, and they must be perpendicular, and in the centres of the rings. The rings must be round, hard, perfectly smooth, and must be adjustable upon the ring rail, so as to insure their being exactly concentric with the spindles. This is a point of the first importance, as the durability of the rings and travellers depends largely upon it.

Good rings are speedily converted into bad ones if the spindles are out of the centre. The travellers also wear out more quickly and the yarn breaks down oftener, thus causing waste, and making the spinner dissatisfied with her work. The ring rail must be level, both latitudinally and transversely, and must traverse in a perpendicular line, so that the spindles may be in the centres of the rings throughout the whole of the lift. The copping motion and its connections with the ring rail must be so accurately fitted and adjusted that the ring rail will traverse smoothly and without liability either to jerk or dwell. The thread guides must be set exactly over the centres of the spindles, so that the yarn in its descent to the traveller will form a perfect cone above the top of the bobbin, and not be apparently broken up into several threads. The travellers must be uniform in shape and weight, of fine temper—not too hard. The bobbins must be of well-seasoned timber, smooth, and well balanced. In addition to accuracy in the workmanship of the machine, it is important that the length of lift, diameter of ring, diameter of bobbin, and guage or space of spindles should be suitable for the numbers to be spun. On these points the following table may be useful, as showing the practice of American spinners:—

Numbers of Yarn.	Guage or Space. Ins.	Lift. Ins.	Diameter of Ring. Ins.	Diameter of Bobbin. Ins.
10's to 13's	3	6	$1\frac{7}{8}$ to 2	$\frac{13}{16}$ to $\frac{7}{8}$
16's to 20's	$2\frac{3}{4}$	6	$1\frac{3}{4}$ to $1\frac{7}{8}$	$\frac{13}{16}$
24's to 26's	$2\frac{3}{4}$	$5\frac{1}{2}$	$1\frac{5}{8}$ to $1\frac{3}{4}$	$\frac{3}{4}$ to $\frac{13}{16}$
30's to 36's	$2\frac{5}{8}$	5	$1\frac{1}{2}$ to $1\frac{5}{8}$	$\frac{3}{4}$
40's to 50's	$2\frac{1}{2}$	$4\frac{1}{2}$ to 5	$1\frac{3}{8}$ to $1\frac{1}{2}$	$\frac{11}{16}$ to $\frac{3}{4}$

In ring spinning cleanliness is a necessity.

Fly must not be allowed to accumulate, especially on the ring rails or on the travellers.

If the travellers become loaded with fly, their weight is very gently increased, and they wear out faster, while the ends break down oftener, in consequence of the increased drag upon the yarn. Nothing makes the spinners' work so agreeable as a clean frame. When fly and dirt are not allowed to accumulate, the work is light; but when carelessness and neglect are allowed to creep in, then dirt breaks the ends down as fast as they can be pieced up, thus leaving no time to clean, and waste reigns supreme.

When frames are running with the rovings struggling to the rollers through a mass of "shell" and fly in the guide—with creel spikes blunt at the points, and the roving coming off by jerks—with middle fluted rollers covered with laps unnoticed and unsuspected, with thread boards and ring rails covered with fly, everything betokens slovenliness and neglect, surprise need not be expressed if they are "doing badly." It would be more than surprising if they were to do well.

When the spinners learn that cleanliness means less work and more money they are not slow to accommodate themselves to the requirements of their frames.

The best method of cleaning the travellers is by the use of the traveller brush.

This brush is fitted upon a sheet-iron holder, with the points of the bristles so adjusted as to let the traveller pass without breaking down the yarn. The brush is moved from left to right along the front of the ring rail, and clears the travellers in passing.

In estimating the capabilities of ring frames it is well to take into account, in the first place, the range of numbers on which they have been so long and so successfully used in America. Of fine numbers, as we understand the term, there are in America practically none. The range is from 40's down to 10's as a rule, with some few finer and some coarser. Within these limits the success of the ring frame in America has been complete, and flyer frames have been almost universally thrown aside.

Whether the ring and traveller principle can be used successfully on higher numbers time will show.

As evidence of the capabilities of the ring frame the following statistics, compiled from various sources, are valuable as showing that a wider range and a greater production are practicable with frame spinning than has commonly been supposed:—

Number of Yarn.	Speed of Front Roller.	Speed of Spindle.	Lbs. per Spindle per week of 60 hours.
7's	127	5,000	5·95
10's	123	5,800	4·04
13's	120	6,500	3·07
16's	109	6,500	2·26
20's	102	6,800	1·71
24's	96	7,000	1·34
28's	91	7,200	1·10
30's	88	7,200	1·05
32's	85	7,200	0·91
36's	82	7 300	0·78
40's	78	7,400	0·67
46's	78	7,800	0·58
50's	75	8,000	0 52

The speeds named in the table are not by any means exceptional, as the following reports from mills in Europe will show :—16's, front roller 120; 20's, front roller 110; 25's, front roller 96; 28's, front roller 96; 20's, 2·125 lbs. in 71 hours; 30's, 1·25 in 56 hours; 36's, 1 lb. in 56 hours; 50's, 7·66 ozs. in 56 hours. A frame was exhibited at Boston, in 1875, spinning 100's with the front roller making 96 revolutions, and the spindles 11,000 per minute.

That the ring frame is well adapted for doubling purposes need scarcely be said, as considerable progress had been made in Europe in this direction before it had obtained even a foot-hold for spinning. It will probably be found that for silk, and also for some descriptions of flax and worsted, its capabilities are in no way inferior to those for cotton.

RECENT HYDRAULIC EXPERIMENTS.

By Major Allen Cunningham, R.E.,
Honorary Fellow of King's College, London.

(A Paper read before the Institution of Civil Engineers.)

This Paper was mainly a general account of some extensive experiments on the flow of water in the Ganges Canal, lasting over four years (1874-79). Their principal object was to find a good mode of discharge-measurement for large canals, and to test existing formulæ. There were about 50,000 velocity, and 600 surface-slope-measurements, besides many special experiments. The Ganges Canal, from its great size, from the variety of its branches abounding in long straight reaches, and from the power of control over the water in it, was eminently suited for such experiments. An important feature was the great range of conditions, and therefore also of results obtained. Thus, the chief work was done at thirteen sites in brickwork and in earth, some being rectangular, and others trapezoidal; and varying from 193 to 13 feet in breadth, and from 11 feet to 8 inches in depth; with surface-slopes from 480 to 24 per million, velocities from 7·7 feet to 0·6 foot per second, and discharges from 7,364 to 114 cubic feet per second.

For all systematic velocity-measurements Floats were exclusively used, viz., Surface-floats, Double-floats, and Loaded Rods. Their advantages and disadvantages had been fully discussed in the detailed treatise, "Roorkee Hydraulic Experiments" (1881). They measured only "forward velocity," the practically useful part of the actual velocity. The motion of water, even when tranquil to the eye, was found to be technically "unsteady;" it was inferred that there is no definite velocity at any point; and that the velocity varies everywhere largely, both in direction and in magnitude. The average of (say) fifty forward velocity-meesurements at any one point was pretty constant, so that there must be probably average steady motion. Hence average forward velocity-measurements would be the only ones of much practical use. To obtain these would be tedious and costly; and special arrangements would be required to obviate the effects of a change in the state of water which often occurred in a long experiment, as when velocities at many points were wanted.

As to surface-slope, its measurement (from nearly 600 trials) was found to be such a delicate operation that the result would be of doubtful utility. This would affect the application of all formulæ into which it entered. The water-surface was ascertained, on the average of its oscillations, to be sensibly level across, not convex, as supposed by some writers. There were five hundred and sixty-five sets of vertical velocity-measurements, combined into forty-six series. The forty-six average curves were all very flat and convex downstream (except near an irregular bank), and were approximately parabolas with horizontal axes; the data determined the parameters only very roughly. The maximum velocity-line was usually below the surface, and sank in a rectangular channel, from the centre outwards down to about mid-depth near the banks. Its depression seemed not to depend on the depth, slope, velocity, or wind; probably the air itself being a continuous source of surface-retardation, would permanently depress the maximum velocity, whilst wind failed to effect this owing to its short duration. On any vertical the mid-depth velocity was greater than the mean, and the bed-velocity was the least. The details showed that the mid-depth velocity was nearly as variable from instant to instant as any other, instead of being nearly constant as suggested by the Mississippi experimenters.

The measurement of the mean velocity past a vertical was thought to be of fundamental importance. Loaded rods seemed by far the best for both accuracy and convenience in depths under 15 feet. They should be immersed only 0·94 of the full depth. The chief objection to their use, that (from not dipping into the slack water near the bed) they moved too quickly, was thus for the first time removed. A double-flat with two similar sub-floats at depths of 0·211 and 0·789 of the full depth would also give this mean with more accuracy and convenience than any instrument of its class: this instrument is new. Measurement of the velocity at $\frac{5}{8}$-depth would also afford a fair approximation.

One hundred and fourteen average transverse velocity-curves were prepared from seven hundred and fourteen separate curves. These average curves were all very flat, and were convex down stream (over a level or concave bed), and nearly symmetric in a symmetric section. The velocity was greatest near the centre, or deepest channel, decreased very slowly at first towards both banks, more rapidly with approach to the banks or with shallowing of the depth, very rapidly close to the banks, and was very small at the edges, possibly zero. The figure of the curve was found to be determined by the figure of the bed, a convexity in the bed producing a concavity in the curve and *vice versa*, and more markedly in shallow than in deep water. Curves on the same transversal, at the same site, and with similar conditions, but differing in general velocity, were nearly parallel projections. At the edges there was a strong transverse surface-flow from the edge towards mid-channel, decreasing rapidly with distance from the edge. The discussion showed that it was almost hopeless to seeek the geometric figure of the curves from mere experiment.

Five hundred and eighty one cubic discharges were measured under very varied conditions. The process adopted contained three steps:—(1). Sounding along about fifteen float courses, scattered across the site in eight cross-sections; time, say four hours. (2). Measurement of the mean velocities through the full depths in those float courses, each thrice repeated; time, say four hours. (3). Computation, say two hours. This process was direct and wholly experimental; each step was done in a time which gave some chance of a constant state of water. From an extended comparison of all results under similar conditions, it appeared that the above process yielded, under favourable circumstances, results not likely to differ more than 5 per cent. The sequel showed that in a channel with variable regimen, a discharge-table for a given site must be of at least double-entry, as dependent on the local gauge-reading, and on the velocity or surface-slope.

Special attention was paid to rapid approximations to mean sectional velocity. The mean velocity past the central vertical, the central surface-velocity, and Chézy's quasi-velocity, (*i.e.*, $100\sqrt{RS}$, where $R=$ the hydraulic mean depth, and $S=$ the surface-slope), were tried in detail; thus 100, 76, and 83 average values thereof respectively 581, 313, and 363 detail values. The ratios of these three velocities to the mean velocity were taken out, and compared in detail with Bazin's and Kutter's co-efficients. Other formulæ were contrasted also in slight detail. Kutter's alone seemed to be of general applicability; when the surface-slope measurement is good, and the rugosity-co-efficient known for the site (both doubtful matters), it would probably give results within 7½ per cent of error. Improvement in formulæ could at present be obtained only by increased complexity, and the tentative research would be excessively laborious. Now the first two ratios varied far less than the third: thus their use would probably involve less error than the third, or approximation would be more likely from direct velocity-measurement than from any use of surface-slope. The connection between velocities was probably a closer one than between velocity and slope; the former being perhaps only a geometric, and the latter a physical one. The mean velocity past the central vertical was recommended for use, as not being affected by wind; the reduction-co-efficient could at present only be found by special experiment for each site.

Three current-metres were tried for some time with a special lift, contrived to grip the metre firmly parallel to the current-axis, so as to register only forward velocity, and with a nearly rigid gearing-wire. No useful general results were obtained. Ninety specimens of silt were collected, but no connection could be traced between silt and velocity; it seemed that the silt at any point varied greatly from instant to instant, and that the quantity depended not on the mean velocity, but probably on the silt in the supply water.

Forty measurements of the evaporation from the canal surface were made in a floating pan during twenty-five months. The average daily evaporation was only about $\frac{1}{10}$-inch. The smallness of this result seemed to be due to the coldness of the water (only 63° in May, with 165° in the sun and 105° in the shade).

Lastly, it must suffice to say that great care was taken to insure accuracy in both fieldwork and computation.

ARTIFICIAL GEMS.

P. Weiskopf gives in the *Diamant* the following formulæ for the frit or mass used in Bohemia for making imitations of some of the precious stones :—

Imitation agates.—10 kilos. quartz, 17 kilos. red lead, 3·2 kilos. potash, 2·2 kilos. borax, and 0·1 kilo. arsenic. The quantity of chloride of gold added is equal to that obtained from 0·4 of a ducat.

Agate glass.—10 parts of broken glass is melted, and to it are added 0·15 part suboxide of copper, the same quantity of the oxides of chromium and of maganese, 0·02 part each of oxide of cobalt and nitrate of silver, 0·01 oxide of uranium, 0·4 red argols, 0·3 part bone meal. Each oxide is added alone and at intervals of ten minutes, After heating the mixture for an hour, 0·3 or 0·4 part of fine soot is put in.

Red marble.—80 parts of sand, 40 of potash, 10 of lime, 2 of table salt, 1 of saltpetre, and 0·1 of arsenic. The mixture is melted, and then 25 parts of suboxide of copper and 1 part of saltpetre mixed in.

Artificial turquoise are made in Paris and Vienna that cannot be distinguished by external appearances from the natural product, and when artistically made can only be distinguished by means of the file, being usually softer. They are made from phosphate of alumina and phosphate of copper mixed together and subjected to hydraulic pressure. Even in chemical composition it resembles the natural mineral, which is a hydrated phosphate of alumina with 2 per cent of oxide of copper.

CAN PLANTS ASSIMILATE CARBONIC OXIDE?

A SERIES of experiments made by Stutzer to settle the question as to whether plants can make the same use of carbon monoxide, CO, that they do of the dioxide, CO_2, gave a negative answer. L. Just, in a discussion regarding the conditions of the experiments, showed that they did not justify any definite conclusions. The latter, therefore, instituted a series of new experiments in which no india-rubber tubing was used for making the connections. The vegetating vessel consisted of a flask into which the mixture of air and gas entered through a potash apparatus to absorb all the carbonic acid, and as it made its exit it likewise passed through a potash apparatus in which the carbonic acid could be retained and measured. The liquids required to sustain and nourish the plant were admitted and withdrawn through a peculiar form of funnel that closed air-tight, so that it was not necessary to open the vessel.

In the experiment it was desired to observe the increase or decrease of dry substance in the plants experimented upon. In each series of experiments comparative measurements were made with atmospheric air that contained the usual quantity of carbonic acid, and with air entirely free from it, also with atmospheric air free from carbonic acid, but mixed with carbonic oxide in quantities gradually increasing from $\frac{1}{20}$ per cent up to 80 per cent. These experiments led to the following results:—

1. The carbonic oxide furnished to plants exposed to the light was not used by them.

2. Carbonic oxide injures many kinds of plants, but not until the quantity present exceeds 10 per cent of the atmosphere in which they are. The injury is shown by a disturbance of the chlorophyl formation, diminished assimilation, less growth, and the new formation of organs is smaller. If there is 20 per cent of carbonic oxide in the atmosphere, the injury becomes perceptible at the end of three weeks, but is sooner noticeable the higher the percentage of carbonic oxide. After the removal of the carbonic oxide, the plants are able to overcome, in part, the injury they have suffered, provided the action of the gas did not last too long, and that there was not too much of it present.

3. The chlorophyl granulesdo not possess any special power of absorbing carbonic oxide gas.—*Investigations in the Domain of Agricultural Physics.*

A NEW PHOTO-ELECTRIC BATTERY.

A NEW battery, which gives a current on exposure to the action of light, has been devised by M. Saur. It consists of a square glass vessel, containing a solution of 15 parts common salt and 7 parts sulphate of copper in 106 of water. A porous vessel of mercury is placed in the solution. An electrode of platinum is in the mercury, and another of sulphuret of silver in the saline solution. The electrodes are connected by means of a galvanometer, and the battery is fixed in a box sheltered from light. The closing of the circuit displaces the needle of the galvanometer, and it is seen that the sulphuret of silver is the negative pole. When the needle has come to rest, if the battery is exposed to the light of the sun the deviation increases. If the light is suppressed the needle returns to its original position; if a cloud passes before the sun while the battery is exposed to the light the variations of the needle indicate the fluctuations of the electric current. The effect of the battery is due to the action on the mercury of the bichloride of copper formed by the mixture of common salt and sulphate of copper. The protochloride of copper which is formed reduces the sulphuret of silver; but this reduction requires the intervention of the solar light, which determines the production of the photo-electric current.

A PRACTICABLE SELENIUM PHOTOMETER.

IT is stated that a working selenium photometer has been constructed by Messrs. Siemens and Halske, thus utilizing the well-known property possessed by selenium of varying in electrical conductivity with the amount of light falling upon it. The arrangement consists of a Thomson reflecting galvanometer, receiving light from a lamp at right angles to it, and reflecting the spot of light upon the scale in front. The selenium cell is attached to a blackened tube 3 milimetres in diameter and 15 milimetres long, mounted horizontally on a vertical rod. The same stand that carries the rod is fitted with a graduated bar in the line of the axis of the blackened tube; and a standard candle holder is made to slide along the bar, in the focus, so to speak, of the tube and its cell. The cell is connected in an electrical circuit with a battery and the galvanometer already mentioned; and the spot of light on the scale of the latter is regulated to stand at zero when the selenium cell is kept dark. When it is desired to measure the brilliancy of a light at a known distance, its rays are allowed to reach the selenium, by removing a shutter which protects the latter; and the degree of lessened electrical resistance is thereupon marked by the spot of light on the galvanometer scale. This having been recorded, an equal deflection is sought for by the aid of the standard candle, which is moved backward and forward along the graduated bar for this purpose. The object having been attained, the distance from the cell of the candle and the light to be measured are compared, and the comparative illuminating power of the latter is thus obtained.

NEW FRENCH IRONCLADS.—As a result of a number of experiments lately carried out in France with armour plates of a variety of patterns, and obtained from various sources, both French and foreign, a contract has been concluded between the Minister of Marine and the managers of the Creusot Works for the supply by the latter of the armour for the *Formidable* and *Capitaine Baudin*, two new ironclads of 11,441 tons each, or of almost exactly the same size as the English *Inflexible*; the displacement of the latter being 11,406 tons. The plates are to be 22 inches thick at the strongest, and 14 inches thick at the weakest part of the armour; and consequently the new French vessels will be defensively stronger than any English ironclad at present either afloat or being built. The Creusot firm is also at the present time supplying the armour plates for the *Terrible*, a vessel of 7,184 tons, and for the *Furieux*, a ship of 5,695 tons; the plates for both the vessels being nearly 20 inches thick.

SMOKE ABATEMENT.—We are informed that Messrs. Smith, Elder and Co., have undertaken the publication of the Reports of the Smoke Abatement Committees of London and Manchester for the year 1882, which includes the whole of the Tests of heating and cooking apparatus, fuels, and furnace appliances. Numerous illustrations of apparatus, tables of results, and chemical report on composition of gases given off from domestic grates and stoves, by Professor W. Chandler Roberts, F.R.S., are added, also reports of the Testing Engineer, Mr. D. K. Clark, M. Inst. C.E., explaining the relative efficiency and economy of Kitcheners, Stoves, and Open-Grates. The committee have admitted reports on the methods of avoiding smoke, and on the distribution of heat in rooms from different descriptions of grates, that the volume may be useful to the general public as well as to manufacturers and inventors of heating appliances, and we have no doubt it will prove a unique and valuable work.

THOMPSON'S IMPROVEMENTS IN TAKING UP MOTIONS FOR LOOMS.

THE taking up motion as constructed at present usually consists of a toothed wheel attached to the winding-on roller; an intermediate differential gearing, or as it is mostly termed the stud wheel, and a pinion toothed wheel attached to the ratchet and paul motion, which is actuated at every beat of the battern or slay. To enable a greater or less number of picks or weft per given measurement of cloth to be put into the fabric, the pinion attached to the ratchet and paul motion is so arranged as to be capable of change for one of greater or less number of teeth. But it is obvious that only such changes can be effected as involve a difference of one complete tooth in the pinion wheel. The niceties of modern calico weaving, however, require differences of even the fractional part of a single pick, or shoot of weft, to be made in a quarter of an inch of cloth.

This has been attempted to be accomplished in various ways, but Mr. W. Thompson, a manufacturer of Blackburn, has effected the desired result by a very simple device, in which he uses two change wheels in combination in such a manner that almost any fractional variety of pick may be obtained. The application can be made to existing looms, without special alterations, and at trifling cost, which is a very important feature in these days of keen competition. To enable the combination changes to be readily made, Mr. Thompson has in preparation a table of calculations, which, when published, will prevent, on the part of the loom master, any trouble in obtaining the exact results he may require.

WATERING PLANTS IN POTS.

WATERING plants is one of the most important things in the culture of house plants, and very special care should be devoted to it. Plants ought not to be wet until they need it. It will be evident that they require wetting, if on taking the earth from the pot it crumbles to pieces like dust: a sure sign is to knock on the side of the pot, near the middle, with the finger knuckle. If it gives forth a hollow ring, the plant needs water; if there is a dull sound, there is still moisture enough to sustain the plant. Plants must not be wet more than once or twice a day; on dry, clear days they require more water than on damp, cloudy days. On the other hand the earth must not be allowed to dry out entirely, for that is also very injurious. In wetting them the water must be poured on in such a way that it will run out again through the hole in the bottom of the pot. If the earth gets too dry, it is best to place the pot in water so that the water will saturate the dirt very gradually. They may be watered at any hour of the day, except when the sun is shining on the pot or has just left it; for the earth gets hot when the sun shines on it, and then if cold water is poured on it, it will cool off too rapidly. The best time for watering flowers in summer is the evening, and in winter noon is best. Well water should *never* be used, but always use either rain water or brook water.

Improvements in *car couplings* have been patented by Mr. William H. Swinford, of Cherokee, Ala. The drawhead and coupling pin are of the usual construction, the head of the coupling having an opening through which passes the inner end of a lever, that is pivoted to the end of the car and projects from its sides where it is provided with a crank. A chain attached to an arm on the lever is also attached to a U-shaped ball pivoted to the end of the car. When the lever is pressed down the pin is raised, and when it is turned the ball raises the link for coupling.

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